E/ECE/324
E/ECE/TRANS/505 } Rev.1/Add.93/Amend.2

18 September 1998

AGREEMENT

CONCERNING THE ADOPTION OF UNIFORM TECHNICAL PRESCRIPTIONS FOR WHEELED VEHICLES, EQUIPMENT AND PARTS WHICH CAN BE FITTED AND/OR BE USED ON WHEELED VEHICLES AND THE CONDITIONS FOR RECIPROCAL RECOGNITION OF APPROVALS GRANTED ON THE BASIS OF THESE PRESCRIPTIONS */

(Revision 2, including the amendments entered into force on 16 October 1995)

Addendum 93: Regulation No. 94

Amendment 2

01 series of amendments - Date of entry into force: 12 August 1998

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF VEHICLES WITH REGARD TO THE PROTECTION OF THE OCCUPANTS IN THE EVENT OF A FRONTAL COLLISION

UNITED NATIONS

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*/ Former title of the Agreement:

Agreement Concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, done at Geneva on 20 March 1958.

GE.98-23348

Contents, insert a new paragraph 11, to read:

"11. Transitional provisions . . . . . "

Annexes,

Annex 3, delete "Appendix - 30° Barrier with ASD (Anti Slide Devices)"

Insert titles of new annexes, to read:

"Annex 9 - Definition of the deformable barrier

Annex 10 - Certification procedure for the dummy lower leg and foot"

Text of the Regulation,

Paragraphs 2.3. to 2.5., amend to read:

"2.3. "Vehicle width" means the distance between two planes parallel to the longitudinal median plane (of the vehicle) and touching the vehicle on either side of the said plane but excluding the rear-view mirrors, side marker lamps, tyre pressure indicators, direction indicator lamps, position lamps, flexible mud-guards and the deflected part of the tyre side-walls immediately above the point of contact with the ground;

2.4. "Overlap" means the percentage of the vehicle width directly in line with the barrier face;

2.5. "Deformable barrier face" means a crushable section mounted on the front of a rigid block;"

Paragraph 2.6.1., amend to read:

"2.6.1. ... they have a negative effect on the results of ...."

Paragraph 2.6.3., amend to read:

"2.6.3. ... they have a negative effect on the results of ...."

Paragraph 2.6.5., amend to read:

"2.6.5. The unladen mass, ..."

Paragraph 2.11., amend the words "airbag assembly" to read "airbag".

Paragraph 3.5., should be deleted.

Paragraph 4.2., amend to read:

"... (at present 01 corresponding to the 01 series of amendments), shall indicate ...."

Paragraph 4.4.1., footnote 2/, amend to read:

"... 24 for Ireland, 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30 (vacant), 31 for Bosnia and Herzegovina, 32-36 (vacant), 37 for Turkey, 38-39 (vacant) and 40 for The former Yugoslav Republic of Macedonia. Subsequent numbers ..... to the Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, ..."

Paragraph 5.2.1., amend the reference to "annex 4" to read "annex 8".

Paragraphs 5.2.1.1. to 5.2.1.3., amend to read (including a new footnote 3/):

"5.2.1.1. The head performance criterion (HPC) shall not exceed 1000 and the resultant head acceleration shall not exceed 80 g for more than 3 ms. The latter shall be calculated cumulatively, excluding rebound movement of the head;

5.2.1.2. The neck injury criteria (NIC) shall not exceed the values shown in Figures 1 and 2 3/;

Figure 1

Neck tension criterion

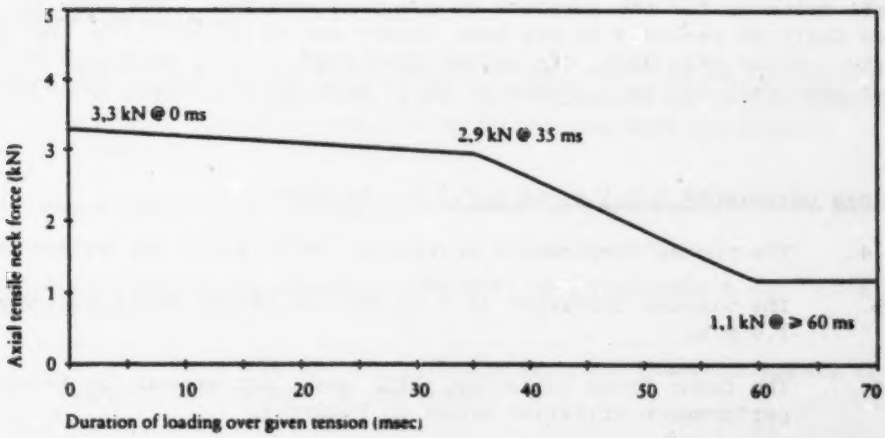
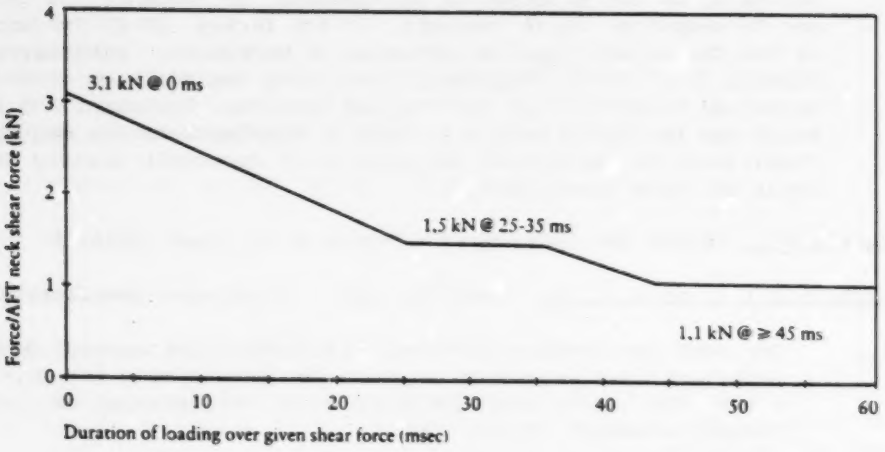


Figure 2

Neck shear criterion



5.2.1.3. The neck bending moment about the y axis shall not exceed 57 Nm in extension 3/;

3/ Until 1 October 1998, the values obtained for the neck shall not be pass/fail criteria for the purposes of granting approval. The results obtained shall be recorded in the test report and be collected by the approval authority. After this date, the values specified in this paragraph shall apply as pass/fail criteria unless or until alternative values are adopted."

Insert new paragraphs 5.2.1.4. to 5.2.1.9., to read:

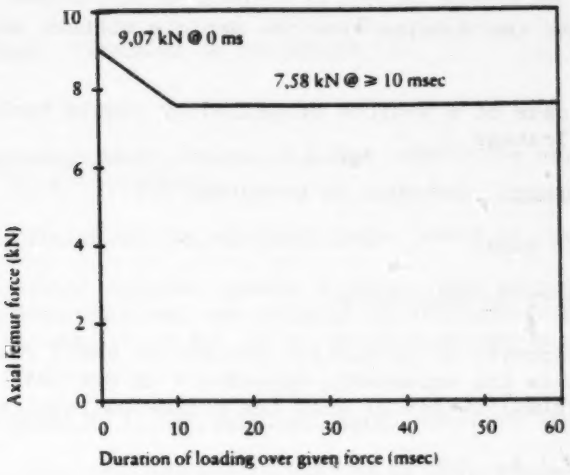
"5.2.1.4. The thorax compression criterion (ThCC) shall not exceed 50 mm;

5.2.1.5. The viscous criterion (V * C) for the thorax shall not exceed 1,0 m/s;

5.2.1.6. The femur force criterion (FFC) shall not exceed the force-time performance criterion shown in Figure 3;

Figure 3

Femur force criterion



5.2.1.7. The tibia compression force criterion (TCFC) shall not exceed 8 kN;

5.2.1.8. The tibia index (TI), measured at the top and bottom of each tibia, shall not exceed 1,3 at either location;

5.2.1.9. The movement of the sliding knee joints shall not exceed 15 mm".

Insert a new paragraph 5.2.2., to read:

"5.2.2. Residual steering wheel displacement, measured at the centre of the steering wheel hub, shall not exceed 80 mm in the upwards vertical direction and 100 mm in the rearward horizontal direction."

Paragraphs 5.2.2. and 5.2.3. (former), renumber as paragraphs 5.2.3. and 5.2.4.

Paragraphs 5.2.4. to 5.2.5. (former), renumber as paragraphs 5.2.5. to 5.2.6. and amend to read:

"... without the use of tools, except for those necessary to support the weight of the dummy:

5.2.5.1. To open at least one door, if there is one, per row of seats and, where there is no such door, to move the seats or tilt their backrests as necessary to allow the evacuation of all the occupants; this is, however, only applicable to vehicles having a roof of rigid construction;

5.2.5.2 To release the dummies from their restraint system which, if locked, shall be capable of being released by a maximum force of 60 N on the centre of the release control;

5.2.5.3. To remove the dummies from the vehicle without adjustment of the seats.

5.2.6. In the case of a vehicle propelled by liquid fuel, no more than slight leakage ...."

Paragraph 5.2.6. (former), renumber as paragraph 5.2.7.

Paragraph 8, amend to read:

"8. CONFORMITY OF PRODUCTION

The conformity of production procedures shall comply with those set out in the Agreement, Appendix 2 (E/ECE/324-E/ECE/TRANS/505/Rev.2) with the following requirements:"

Paragraphs 8.2. to 8.3.4., should be deleted.

Paragraph 8.3.5., renumber as paragraph 8.2. and amend to read:

"8.2. The holder of the approval shall ensure that for each type of vehicle at least the tests concerning the taking of measurements are carried out."

Paragraphs 8.3.6. to 8.4.2., should be deleted.

Paragraph 8.4.3., renumber as paragraph 8.3. and amend to read:

"8.3. The authority which has granted type approval may at any time verify the conformity control methods applied in each production facility. The normal frequency of these verifications shall be once every two years."

Insert new paragraphs 11 to 11.3., to read:

"11. TRANSITIONAL PROVISIONS

11.1. As from the official date of entry into force of the 01 series of amendments, no Contracting Party applying this Regulation shall refuse to grant ECE approval under this Regulation as amended by the 01 series of amendments.

11.2. As from 1 October 1998 Contracting Parties applying this Regulation shall grant ECE approvals only to those types of vehicles which comply with the requirements of this Regulation as amended by the 01 series of amendments.

11.3. As from 1 October 2003 Contracting Parties applying this Regulation may refuse first national registration (first entry into service) of vehicles which do not meet the requirements of this Regulation as amended by the 01 series of amendments."

Paragraph 11 (former), renumber as paragraph 12.

Annex 2,

Examples of the approval mark, models A and B, amend the approval number "001424" to read "011424" (twice).

The caption below model A of the approval mark, amend to read:

"..... under approval number 011424. The approval number indicates that the approval was granted in accordance with the requirements of Regulation No. 94 as amended by the 01 series of amendments."

The caption below model B of the approval mark, amend to read:

"..... when the respective approvals were granted, Regulation No. 94 incorporated the 01 series of amendments and Regulation No. 11 incorporated the 02 series of amendments."

Annex 3,

Paragraph 1.1., (French only).

Paragraph 1.2., amend to read:

"1.2. Barrier

The front face of the barrier consists of a deformable structure as defined in annex 9 of this Regulation. The front face of the deformable structure is perpendicular within ± 1° to the direction of travel of the test vehicle. The barrier is secured to a mass of not less than 7×10^4 kg, the front face of which is vertical within ± 1°. The mass is anchored in the ground or placed on the ground with, if necessary, additional arresting devices to restrict its movement."

Paragraph 1.3., amend to read:

"1.3. Orientation of the barrier

The orientation of the barrier is such that the first contact of the vehicle with the barrier is on the steering-column side. Where there is a choice between carrying out the test with a right-hand or left-hand drive vehicle, the test shall be carried out with the less favourable hand of drive as determined by the technical service responsible for the tests."

Insert a new paragraph 1.3.1., to read:

"1.3.1. Alignment of the vehicle to the barrier

The vehicle shall overlap the barrier face by 40 per cent ± 20 mm."

Paragraph 1.4.2.2., amend to read:

"... by the manufacturer with a tolerance of ± 1 per cent."

Paragraph 1.4.2.4., amend to read:

"1.4.2.4. If the mass of the measuring apparatus on board the vehicle exceeds the 25 kg allowed, it may be compensated by reductions which have no noticeable effect on the results measured under paragraph 6 below."

Insert a new paragraph 1.4.2.5., to read:

"1.4.2.5. The mass of the measuring apparatus shall not change each axle reference load by more than 5%, each variation not exceeding 20 kg."

Paragraph 1.4.2.5. (former), renumber as paragraph 1.4.2.6.

Paragraph 1.4.3.4., amend to read:

"1.4.3.4. Pedals

The pedals shall be in their normal position of rest. If adjustable, they shall be set in their mid position unless another position is specified by the manufacturer."

Paragraph 2.1.1., amend to read (footnote 1/ not modified):

"2.1.1. A dummy corresponding to the specifications for HYBRID III 1/ fitted with a 45° ankle and meeting the specifications ... annex 8. The ankle of the dummy shall be certified in accordance with the procedures in annex 10."

Paragraph 2.1.2., should be deleted.

Paragraph 2.1.3., renumber as paragraph 2.1.2.

Paragraphs 2.2. to 2.2.2., should be deleted.

Paragraph 3, amend to read:

"3. Propulsion and course of vehicle

3.1. The vehicle shall be propelled either by its own engine or by any other propelling device.

3.2. At the moment of impact the vehicle shall no longer be subject to the action of any additional steering or propelling device.

3.3. The course of the vehicle shall be such that it satisfies the requirements of paragraphs 1.2. and 1.3.1."

Paragraph 4, amend the value of "50 +0, -2 km/h" to read "56 -0/+1 km/h".

Paragraphs 5.2.1. to 5.2.3., amend to read:

"5.2.1. Measurements in the head of the dummy

The acceleration (a) referring to the centre of gravity is calculated from the triaxial components of the acceleration measured with a CFC of 1000.

5.2.2. Measurements in the neck of the dummy

5.2.2.1. The axial tensile force and the fore/aft shear force at the neck/head interface are measured with a CFC of 1000.

5.2.2.2. The bending moment about a lateral axis at the neck/head interface are measured with a CFC of 600.

5.2.3. Measurements in the thorax of the dummy

The chest deflection between the sternum and the spine is measured with a CFC of 180.

5.2.4. Measurements in the femur and tibia of the dummy

5.2.4.1. The axial compressive force and the bending moments are measured with a CFC of 600.

5.2.4.2. The displacement of the tibia with respect to the femur is measured at the knee sliding joint with a CFC of 180.

Annex 3 - Appendix. should be deleted.

Annex 4, amend to read:

"Annex 4

DETERMINATION OF PERFORMANCE CRITERIA

1. HEAD PERFORMANCE CRITERION (HPC)

1.1. This criterion is considered to be satisfied when, during the test, there is no contact between the head and any vehicle component.

1.2. If that is not the case, a calculation of the value of HPC is made, on the basis of the acceleration (a), measured according to paragraph 5.2.1. of annex 3, by the following expression:

$$HPC = (t_2 - t_1)\left[\frac{1}{t_2 - t_1}\int_{t_1}^{t_2} a\,dt\right]^{2.5}$$

in which:

1.2.1. the term 'a' is the resultant acceleration measured according to paragraph 5.2.1. of annex 3 and is measured in units of gravity, g (1 g = 9,81 m/s^2);

1.2.2. if the beginning of the head contact can be determined satisfactorily, t_1 and t_2 are the two time instants, expressed in seconds, defining an interval between the beginning of the head contact and the end of the recording for which the value of HPC is maximum;

1.2.3. if the beginning of the head contact cannot be determined, t_1 and t_2 are the two time instants, expressed in seconds, defining a time interval between the beginning and the end of the recording for which the value of HPC is maximum.

1.2.4. Values of HPC for which the time interval (t_1 - t_2) is greater than 36 ms are ignored for the purposes of calculating the maximum value.

1.3. The value of the resultant head acceleration during forward impact which is exceeded for 3 ms cumulatively is calculated from the resultant head acceleration measured according to paragraph 5.2.1. of annex 3.

2. NECK INJURY CRITERIA (NIC)

2.1. These criteria are determined by the compressive axial force, the axial tensile force and the fore/aft shear forces at the head/neck interface, expressed in kN and measured according to

paragraph 5.2.2. of annex 3 and by the duration of these forces expressed in ms.

2.2. The neck bending moment criterion is determined by the bending moment, expressed in Nm, about a lateral axis at the head/neck interface and measured according to paragraph 5.2.2. of annex 3.

2.3. The neck flexion bending moment, expressed in Nm, shall be recorded.

3. THORAX COMPRESSION CRITERION (ThCC) AND VISCOUS CRITERION (V * C)

3.1. The thorax compression criterion is determined by the absolute value of the thorax deformation, expressed in mm and measured according to paragraph 5.2.3. of annex 3.

3.2. The viscous criterion (V * C) is calculated as the instantaneous product of the compression and the rate of deflection of the sternum, measured according to paragraph 6 and also paragraph 5.2.3. of annex 3.

4. FEMUR FORCE CRITERION (FFC)

4.1. This criterion is determined by the compression load expressed in kN, transmitted axially on each femur of the dummy and measured according to paragraph 5.2.4. of annex 3 and by the duration of the compressive load expressed in ms.

5. TIBIA COMPRESSIVE FORCE CRITERION (TCFC) AND TIBIA INDEX (TI)

5.1. The tibia compressive force criterion is determined by the compressive load (F_z) expressed in kN, transmitted axially on each tibia of the dummy and measured according to paragraph 5.2.4. of annex 3.

5.2. The tibia index is calculated on the basis of the bending moments (M_x and M_y) measured according to paragraph 5.1. by the following expression:

$$TI = |M_R / (M_C)_R| + |F_Z / (F_C)_Z|$$

where:

M_X = bending moment about the x axis
M_Y = bending moment about the y axis
$(M_C)_R$ = critical bending moment and shall be taken to be 225 Nm
F_Z = compressive axial force in the z direction
$(F_C)_Z$ = critical compressive force in the z direction and shall be taken to be 35,9 kN and

$$M_R = \sqrt{(M_X)^2 + (M_Y)^2}$$

The tibia index is calculated for the top and the bottom of each tibia; however, F_z may be measured at either location. The value obtained is used for the top and bottom TI calculations. Moments M_x and M_y are both measured separately at both locations.

6. PROCEDURE FOR CALCULATING THE VISCOUS CRITERIA (V * C) FOR HYBRID III DUMMY

6.1. The viscous criterion is calculated as the instantaneous product of the compression and the rate of deflection of the sternum. Both are derived from the measurement of sternum deflection.

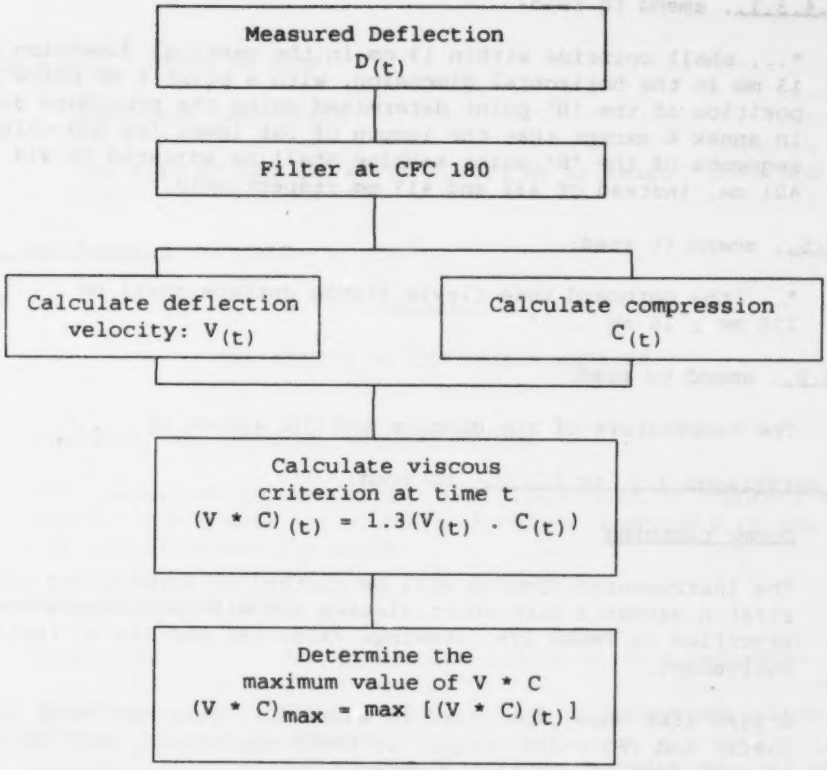
6.2. The sternum deflection response is filtered once at CFC 180. The compression at time t is calculated from this filtered signal as:

$$C_{(t)} = \frac{D_{(t)}}{0.229}$$

The sternum deflection velocity at time t is calculated from the filtered deflection as:

$$V_{(t)} = \frac{8(D_{(t+1)} - D_{(t-1)}) - (D_{(t+2)} - D_{(t-2)})}{12\partial t}$$

where $D_{(t)}$ is the deflection at time t in metres and ∂t is the time interval in seconds between the measurements of deflection. The maximum value of ∂t shall be $1,25 \times 10^{-4}$ seconds. This calculation procedure is shown diagrammatically below:


Measured Deflection
$D_{(t)}$
Filter at CFC 180
Calculate deflection velocity: $V_{(t)}$
Calculate compression $C_{(t)}$
Calculate viscous criterion at time t
$(V * C)_{(t)} = 1.3(V_{(t)} \cdot C_{(t)})$
Determine the maximum value of V * C
$(V * C)_{max} = max [(V * C)_{(t)}]$

"

Annex 5,

Paragraph 1.4., should be deleted.

Paragraph 2.1., amend the words "horizontal within 1/2 degree" to read "horizontal within 2.5°" (twice).

Paragraph 2.3.1., amend to read:

"... a force of not less than 9 N and not more than 22 N, the tape shall ...."

Paragraph 2.4.2., amend the words "bucket seat(s)" to read "individual seat(s)" (twice).

Paragraph 2.4.3.1., amend to read:

"... shall coincide within 13 mm in the vertical dimension and 13 mm in the horizontal dimension, with a point 6 mm below the position of the 'H' point determined using the procedure described in annex 6 except that the length of the lower leg and thigh segments of the "H" point machine shall be adjusted to 414 and 401 mm, instead of 432 and 417 mm respectively."

Paragraph 2.5., amend to read:

"... the outboard knee clevis flange surface shall be 270 mm ± 10 mm ...."

Paragraph 2.8., amend to read:

"2.8. The temperature of the dummies and the system of ...."

Insert new paragraphs 2.9. to 2.9.2., to read:

"2.9. Dummy clothing

2.9.1. The instrumented dummies will be clothed in formfitting cotton stretch garments with short sleeves and mid-calf length trousers specified in FMVSS 208, drawings 78051-292 and 293 or their equivalent.

2.9.2. A size 11EE shoe, specified in FMVSS 208, drawings 78501-294 (left) and 78501-295 (right) or their equivalent, will be placed on each foot of the test dummies."

Paragraph 3, amend to read:

".... Apply a 9 to 18 N tension load to the lap belt...."

Annex 7,

Paragraph 1.3.4., amend to read:

"1.3.4. The angle between the longitudinal axis of the vehicle and the direction of motion of the trolley shall be 0° ± 2°."

Paragraph 1.6., correct the value of "± 1 ms" to read "± 1 m/s".

Paragraph 1.7., (French only).

Annex 8,

Paragraph 5.2.2., amend to read:

"5.2.2. Amplitude resolution

The size of digital words should be at least 7 bits and a parity bit."

Insert a new Annex 9, to read:

"Annex 9

DEFINITION OF DEFORMABLE BARRIER

1. COMPONENT AND MATERIAL SPECIFICATIONS

The dimensions of the barrier are illustrated in Figure 1 of this annex. The dimensions of the individual components of the barrier are listed separately below.

1.1. Main honeycomb block

Dimensions	All dimensions should allow a tolerance of ± 2,5 mm
Height:	650 mm (in direction of honeycomb ribbon axis)
Width:	1000 mm
Depth:	450 mm (in direction of honeycomb cell axes)
Material:	Aluminium 3003 (ISO 209, part 1)
Foil Thickness:	0.076 mm
Cell Size:	19.14 mm
Density:	28.6 kg/m^3
Crush Strength:	0.342 MPa +0% -10% 1/

1.2. Bumper element

Dimensions	All dimensions should allow a tolerance of ± 2,5 mm
Height:	330 mm (in direction of honeycomb ribbon axis)
Width:	1000 mm
Depth:	90 mm (in direction of honeycomb cell axes)
Material:	Aluminium 3003 (ISO 209, part 1)
Foil Thickness:	0.076 mm
Cell size:	6.4 mm
Density:	82.6 kg/m^3
Crush Strength:	1.711 MPa +0% -10% 1/

1/ In accordance with the certification procedure described in paragraph 2 of this annex.

1.3. Backing sheet

Dimensions	
Height:	800 mm ± 2,5 mm
Width:	1000 mm ± 2,5 mm
Thickness:	2.0 mm ± 0.1 mm

1.4. Cladding sheet

Dimensions	
Length:	1700 mm ± 2,5 mm
Width:	1000 mm ± 2,5 mm
Thickness:	0.81 ± 0.07 mm
Material:	Aluminium 5251/5052 (ISO 209, part 1)

1.5. Bumper facing sheet

Dimensions	
Height:	330 mm ± 2,5 mm
Width:	1000 mm ± 2,5 mm
Thickness:	0.81 mm ± 0.07 mm
Material:	Aluminium 5251/5052 (ISO 209, part 1)

Adhesive

The adhesive to be used throughout should be a two-part polyurethane (such as Ciba-Geigy XB5090/1 resin with XB5304 hardener, or equivalent).

2. ALUMINIUM HONEYCOMB CERTIFICATION

A complete testing procedure for certification of aluminium honeycomb is given in NHTSA TP-214D. The following is a summary of the procedure that should be applied to materials for the frontal impact barrier, these materials having a crush strength of 0.342 MPa and 1.711 MPa respectively.

2.1. Sample locations

To ensure uniformity of crush strength across the whole of the barrier face, eight samples shall be taken from four locations evenly spaced across the honeycomb block. For a block to pass certification, seven of these eight samples shall meet the crush strength requirements of the following sections.

The location of the samples depends on the size of the honeycomb block. First, four samples, each measuring 300 mm x 300 mm x 50 mm thick shall be cut from the block of barrier face material. Please refer to Figure 2 for an illustration of how to locate these sections within the honeycomb block. Each of these larger samples shall be cut into samples for certification testing (150 mm x 150 mm x 50 mm). Certification shall be based on the testing of two samples from each

of these four locations. The other two should be made available to the applicant, upon request.

2.2. Sample size

Samples of the following size shall be used for testing:

Length: 150 mm ± 6 mm
Width: 150 mm ± 6 mm
Thickness: 50 mm ± 2 mm

The walls of incomplete cells around the edge of the sample shall be trimmed as follows:

In the "W" direction, the fringes shall be no greater than 1.8 mm (see Figure 3).

In the "L" direction, half the length of one bonded cell wall (in the ribbon direction) shall be left at either end of the specimen (see Figure 3).

2.3. Area measurement

The length of the sample shall be measured in three locations, 12.7 mm from each end and in the middle, and recorded as L1, L2 and L3 (Figure 3). In the same manner, the width shall be measured and recorded as W1, W2 and W3 (Figure 3). These measurements shall be taken on the centreline of the thickness. The crush area shall then be calculated as:

$$A = \frac{(L1+L2+L3)}{3} \times \frac{(W1+W2+W3)}{3}$$

2.4. Crush rate and distance

The sample shall be crushed at a rate of not less than 5.1 mm/min and not more than 7.6 mm/min. The minimum crush distance shall be 16.5 mm.

2.5. Data collection

Force versus deflection data are to be collected in either analog or digital form for each sample tested. If analog data are collected then a means of converting this to digital shall be available. All digital data shall be collected at a rate of not less than 5 Hz (5 points per second).

2.6. Crush strength determination

Ignore all data prior to 6.4 mm of crush and after 16.5 mm of crush. Divide the remaining data into three sections or displacement intervals (n = 1, 2, 3) (see Figure 4) as follows:

(1) 06.4 mm - 09.7 mm inclusive,
(2) 09.7 mm - 13.2 mm exclusive,
(3) 13.2 mm - 16.5 mm inclusive.

Find the average for each section as follows:

$$F(n) = \frac{(F(n)1+F(n)2+\ldots+F(n)m)}{m}; \quad m = 1, 2, 3$$

where m represents the number of data points measured in each of the three intervals. Calculate the crush strength of each section as follows:

$$S(n) = \frac{F(n)}{A}; \quad n = 1, 2, 3$$

2.7. Sample crush strength specification

For a honeycomb sample to pass this certification, the following conditions shall be met:

0.308 MPa ≤ S(n) ≤ 0.342 MPa for 0.342 MPa material
1.540 MPa ≤ S(n) ≤ 1.711 MPa for 1.711 MPa material

n = 1, 2, 3.

2.8. Block crush strength specification

Eight samples are to be tested from four locations, evenly spaced across the block. For a block to pass certification, seven of the eight samples shall meet the crush strength specification of the previous section.

3. ADHESIVE BONDING PROCEDURE

3.1. Immediately before bonding, aluminium sheet surfaces to be bonded shall be thoroughly cleaned using a suitable solvent, such as 1-1-1 Trichloroethane. This is to be carried out at least twice or as required to eliminate grease or dirt deposits. The cleaned surfaces shall then be abraded using 120 grit abrasive paper. Metallic/Silicon Carbide abrasive paper is not to be used. The surfaces shall be thoroughly abraded and the abrasive paper changed regularly during the process to avoid clogging, which may lead to a polishing effect. Following abrading, the surfaces shall be thoroughly cleaned again, as above. In total, the surfaces shall be solvent cleaned at least four times. All dust and deposits left as a result of the abrading process shall be removed, as these will adversely affect bonding.

3.2. The adhesive should be applied to one surface only, using a ribbed rubber roller. In cases where honeycomb is to be bonded to aluminium sheet, the adhesive should be applied to the aluminium sheet only.

A maximum of 0.5 kg/m^2 shall be applied evenly over the surface, giving a maximum film thickness of 0.5 mm.

4. CONSTRUCTION

4.1. The main honeycomb block shall be bonded to the backing sheet with adhesive such that the cell axes are perpendicular to the sheet. The cladding shall be bonded to the front surface of the honeycomb block. The top and bottom surfaces of the cladding sheet shall not be bonded to the main honeycomb block but should be positioned closely to it. The cladding sheet shall be adhesively bonded to the backing sheet at the mounting flanges.

4.2. The bumper element shall be adhesively bonded to the front of the cladding sheet such that the cell axes are perpendicular to the sheet. The bottom of the bumper element shall be flush with the bottom surface of the cladding sheet. The bumper facing sheet shall be adhesively bonded to the front of the bumper element.

4.3. The bumper element shall then be divided into three equal sections by means of two horizontal slots. These slots shall be cut through the entire depth of the bumper section and extend the whole width of the bumper. The slots shall be cut using a saw; their width shall be the width of the blade used and shall not exceed 4.0 mm.

4.4. Clearance holes for mounting the barrier are to be drilled in the mounting flanges (shown in Figure 5). The holes shall be of 9.5 mm diameter. Five holes shall be drilled in the top flange at a distance of 40 mm from the top edge of the flange and five in the bottom flange, 40 mm from the bottom edge of that flange. The holes shall be at 100 mm, 300 mm, 500 mm, 700 mm, 900 mm from either edge of the barrier. All holes shall be drilled to ± 1 mm of the nominal distances.

5. MOUNTING

5.1. The deformable barrier shall be rigidly fixed to the edge of a mass of not less than 7×10^4 kg or to some structure attached thereto. The attachment of the barrier face shall be such that the vehicle shall not contact any part of the structure more than 75 mm from the top surface of the barrier (excluding the upper flange) during any stage of the impact 2/. The front face of the surface to which the deformable barrier is attached shall be flat and continuous over the height and width of the face and shall be vertical ± 1° and perpendicular ± 1° to the axis of the run-up track. The attachment surface shall not be displaced by more than 10 mm during the test. If necessary, additional anchorage or arresting devices shall be used to prevent displacement of the concrete block. The edge of the

---

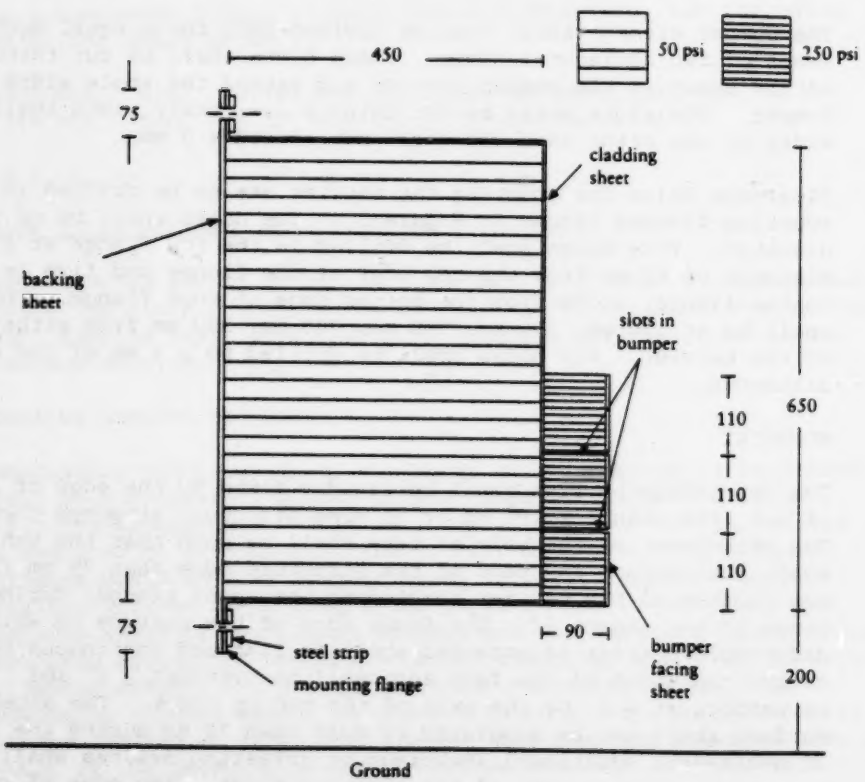
2/ A mass, the end of which is between 925 mm and 1,000 mm high and at least 1,000 mm deep, is considered to satisfy this requirement.

deformable barrier shall be aligned with the edge of the concrete block appropriate for the side of the vehicle to be tested.

5.2. The deformable barrier shall be fixed to the concrete block by means of ten bolts, five in the top mounting flange and five in the bottom. These bolts shall be of at least 8 mm diameter. Steel clamping strips shall be used for both the top and bottom mounting flanges (see Figures 1 and 5). These strips shall be 60 mm high and 1000 mm wide and have a thickness of at least 3 mm. Five clearance holes of 9.5 mm diameter shall be drilled in both strips to correspond with those in the mounting flange on the barrier (see paragraph 4). None of the fixtures shall fail in the impact test.

Figure 1

Deformable barrier for frontal impact testing

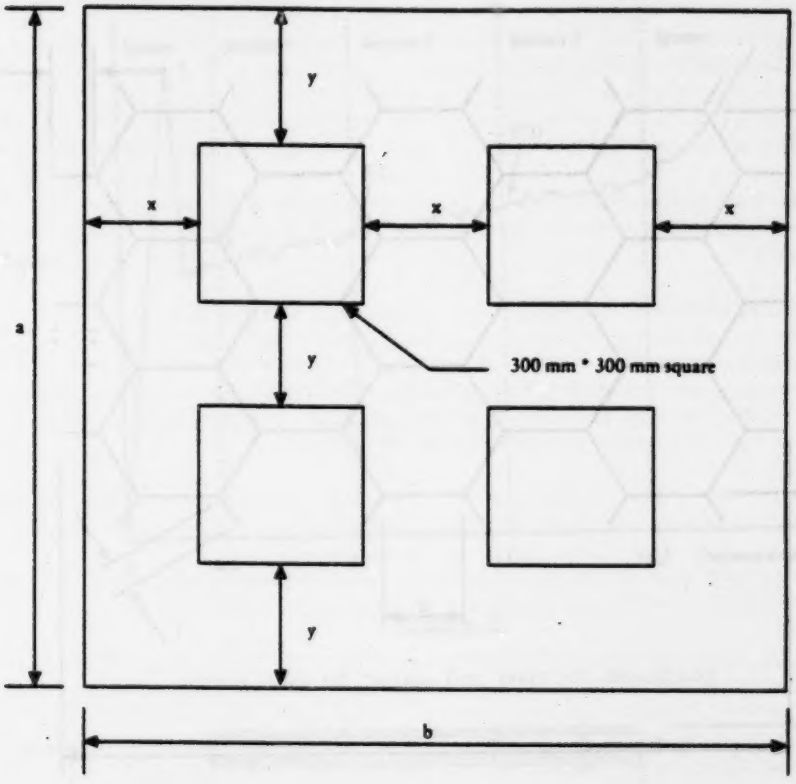


Barrier width = 1 000 mm.

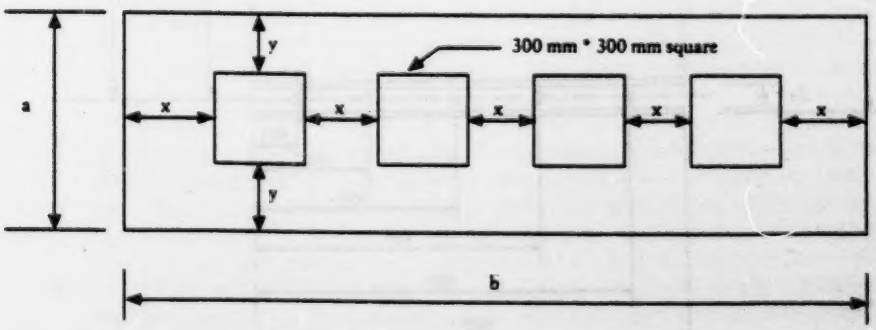
All dimensions in mm.

Figure 2

Locations of samples for certification



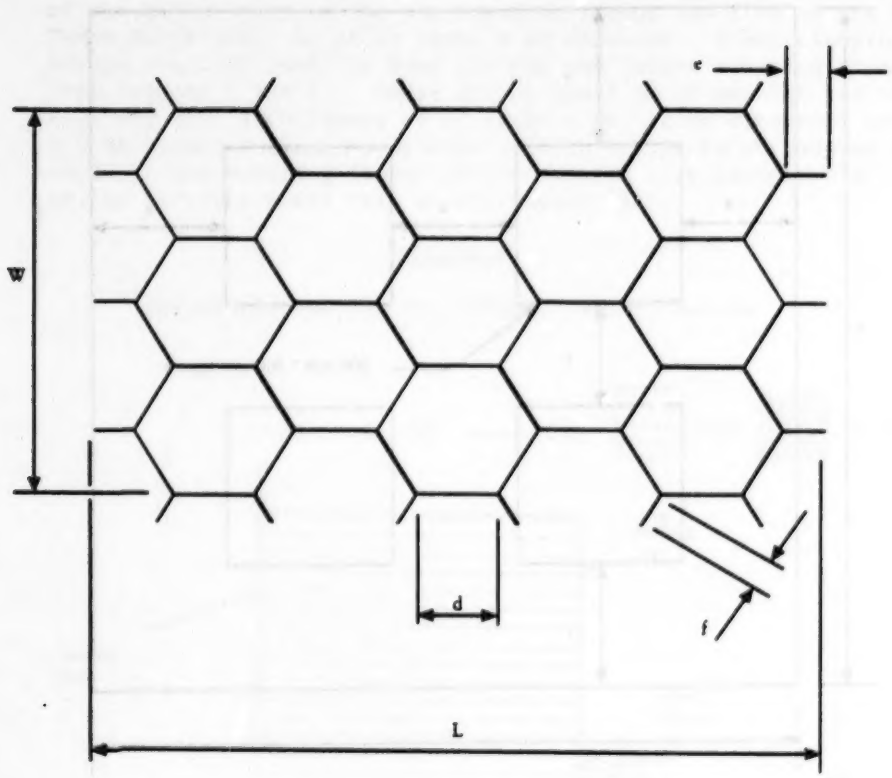
If a ≥ 900 mm: x = 1/3 (b-600mm) and y = 1/3 (a-600mm) (for a ≤ b)



If a < 900 mm: x = 1/5 (b-1200mm) and y = 1/2 (a-300mm) (for a ≤ b)

Figure 3

Honeycomb axes and measured dimensions



e = d/2
f = 0,8 mm

Figure 4

Crush force and displacement

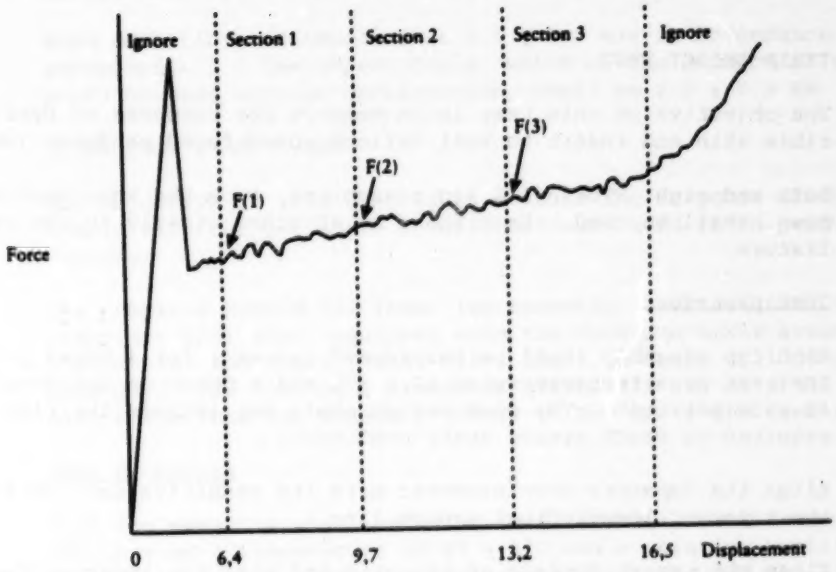
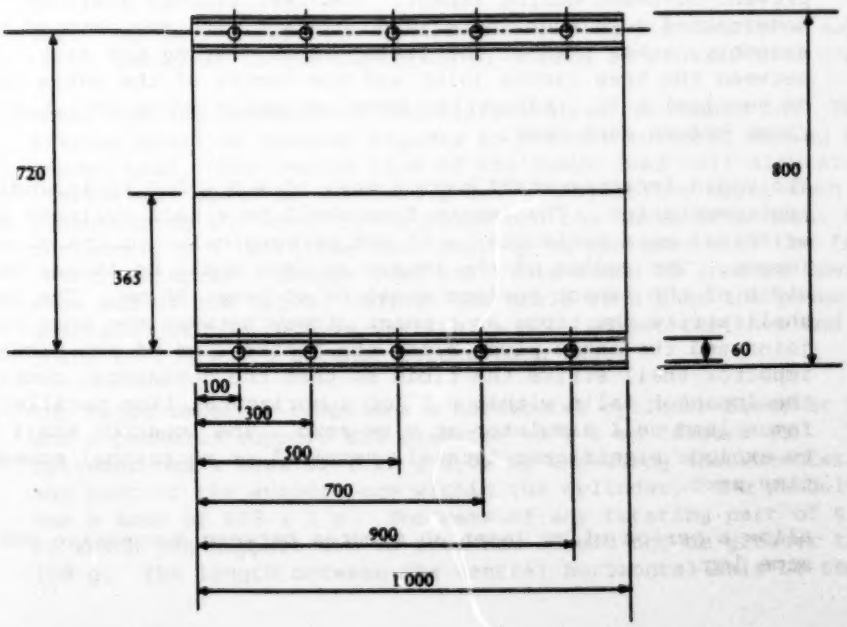


Figure 5

Positions of holes for barrier mounting



Hole diameters 9,5 mm.
All dimensions in mm.

Insert a new Annex 10, to read:

"Annex 10

CERTIFICATION PROCEDURE FOR THE DUMMY LOWER LEG AND FOOT

1. TIBIA IMPACT TEST

1.1. The objective of this test is to measure the response of Hybrid III tibia skin and insert to well-defined, hard-faced pendulum impacts.

1.2. Left and right Hybrid III leg assemblies, from the knee clevis joint down, shall be used. Each shall be attached rigidly to the test fixture.

1.3. Test procedure

1.3.1. Each leg assembly shall be maintained (soaked) for 4 hours prior to the test at a temperature of 22 ± 3°C and a relative humidity of 40 ± 30 per cent. The soak period shall not include the time required to reach steady state conditions.

1.3.2. Align the impactor accelerometer with its sensitive axis parallel to the impactor longitudinal centre line.

1.3.3. Clean the impact surface of the skin and also the impactor face with isopropyl alcohol or equivalent prior to the test.

1.3.4. Mount the leg assembly to the fixture at the knee clevis joint, as shown in Figure 1. The text fixture shall be rigidly secured to prevent movement during impact. The test fixture shall be constructed such that there is no contact with any part of the leg assembly, other than at the fixing point, during the test. The line between the knee clevis joint and the centre of the ankle joint shall be vertical ± 5°. Adjust the knee and ankle joint to 1,5 ± 0,5 g range before each test.

1.3.5. The rigid impactor shall have a mass of 5,0 ± 0,2 kg including instrumentation. The impact face shall be a half cylinder with its principal axis horizontal ± 1° and perpendicular to the direction of impact. The radius of the impact surface shall be 40 ± 2 mm and the width of the impact surface shall be at least 80 mm. The impactor shall strike the tibia at a point midway between the knee clevis joint and the ankle pivot along the centre line of the tibia. The impactor shall strike the tibia so that the horizontal centre line of the impactor falls within 0,5° of a horizontal line parallel to the femur load cell simulator at time-zero. The impactor shall be guided to exclude significant lateral, vertical or rotational movement at time-zero.

1.3.6. Allow a period of at least 30 minutes between successive tests on the same leg.

1.3.7. The data acquisition system, including transducers, shall conform to the specifications for CFC 600, as described in annex 8.

1.4. Performance specification

1.4.1. When each tibia is impacted at 2.1 ± 0,3 m/s in accordance with paragraph 1.3., the impact force, which is the product of the pendulum mass and the deceleration, shall be 2.3 ± 0,3 kN.

2. UPPER FOOT IMPACT TEST

2.1. The objective of this test is to measure the response of the Hybrid III foot and ankle to well-defined, hard-faced pendulum impacts.

2.2. The complete Hybrid III lower leg assembly, left (86-5001-001) and right (86-5001-002), equipped with the foot and ankle assembly, left (78051-614) and right (78051-615), shall be used, including the knee assembly. The load cell simulator (78051-319 Rev A) shall be used to secure the knee-cap assembly (78051-16 Rev B) to the test fixture.

2.3. Test procedure

2.3.1. Each leg assembly shall be maintained (soaked) for 4 hours prior to the test at a temperature of 22 ± 3°C and a relative humidity of 40 ± 30 per cent. The soak period shall not include the time required to reach steady state conditions.

2.3.2. (a) Clean the impact surface of the skin and also the impactor face with isopropyl alcohol or equivalent prior to the test.

(b) Align the impactor accelerometer with its sensitive axis parallel to the direction of impact at contact with the foot.

2.3.3. Mount the leg assembly to the fixture shown in Figure 1a. The test fixture shall be secured rigidly to prevent movement during the impact test. The centre line of the femur load cell simulator (78051-319) shall be vertical ± 0,5°. Adjust the mount such that the line joining the knee clevis joint and the ankle attachment bolt is horizontal ± 3° with the heel resting on two sheets of low-friction (PTFE) material. Ensure that the tibia flesh is located towards the knee end of the tibia. Adjust the ankle such that the plane of the underside of the foot is vertical ± 3°. Adjust the knee and ankle joint to 1,5 ± 0,5 g range before each test.

2.3.4. The rigid impactor comprises a horizontal cylinder diameter 50 ± 2 mm and a pendulum support arm diameter 19 ± 1 mm (Figure 3a). The cylinder has a mass of 1,25 ± 0,02 kg including instrumentation and any part of the support arm within the cylinder. The pendulum arm has a mass of 285 ± 5 g. The mass of any rotating part of the axle to which the support arm is attached should not be greater than 100 g. The length between the central horizontal axis of the

impactor cylinder and the axis of rotation of the whole pendulum shall be 1 250 ± 1 mm. The impact cylinder is mounted with its longitudinal axis horizontal and perpendicular to the direction of impact. The pendulum shall impact the underside of the foot, at a distance of 185 ± 2 mm from the base of the heel resting on the rigid horizontal platform, so that the longitudinal centre line of the pendulum arm falls within 1° of a vertical line at impact. The impactor shall be guided to exclude significant lateral, vertical or rotational movement at time-zero.

2.3.5. Allow a period of at least 30 minutes between successive tests on the same leg.

2.3.6. The data acquisition system, including transducers, shall conform to the specifications for CFC 600, as described in annex 8.

2.4. Performance specifications

2.4.1. When the ball of each foot is impacted at 6,7 ± 0,2 m/s in accordance with paragraph 2.3., the maximum tibia bending moment about the y-axis (M_y) shall be between 100 Nm and 140 Nm.

3. LOWER FOOT IMPACT TEST

3.1. The objective of this test is to measure the response of the Hybrid III foot skin and insert to well-defined, hard-faced pendulum impacts.

3.2. The complete Hybrid III lower leg assembly, left (86-5001-001) and right (86-5001-002), equipped with the foot and ankle assembly, left (78051-614) and right (78051-615), shall be used, including the knee assembly. The load cell simulator (78051-319 Rev A) shall be used to secure the knee-cap assembly (78051-16 Rev B) to the test fixture.

3.3. Test procedure

3.3.1. Each leg assembly shall be maintained (soaked) for 4 hours prior to the test at a temperature of 22 ± 3°C and a relative humidity of 40 ± 30 per cent. The soak period shall not include the time required to reach steady state conditions.

3.3.2. Align the impactor accelerometer with its sensitive axis parallel to the impactor longitudinal centre line.

3.3.3. Clean the impact surface of the skin and also the impactor face with isopropyl alcohol or equivalent prior to the test.

3.3.4. Mount the leg assembly to the fixture shown in Figure 1b. The test fixture shall be secured rigidly to prevent movement during the impact test. The centre line of the femur load cell simulator (78051-319) shall be vertical ± 0,5°. Adjust the mount such that the line joining the knee clevis joint and the ankle attachment bolt is

horizontal ± 3° with the heel resting on two sheets of low-friction (PTFE) material. Ensure that the tibia flesh is located towards the knee end of the tibia. Adjust the ankle such that the plane of the underside of the foot is vertical ± 3°. Adjust the knee and ankle joint to 1,5 ± 0,5 g range before each test.

3.3.5. The rigid impactor comprises a horizontal cylinder diameter 50 ± 2 mm and a pendulum support arm diameter 19 ± 1 mm (Figure 3a). The cylinder has a mass of 1,25 ± 0,02 kg including instrumentation and any part of the support arm within the cylinder. The pendulum arm has a mass of 285 ± 5 g. The mass of any rotating part of the axle to which the support arm is attached should not be greater than 100 g. The length between the central horizontal axis of the impactor cylinder and the axis of rotation of the whole pendulum shall be 1 250 ± 1 mm. The impact cylinder is mounted with its longitudinal axis horizontal and perpendicular to the direction of impact. The pendulum shall impact the underside of the foot, at a distance of 62 ± 2 mm from the base of the heel resting on the rigid horizontal platform, so that the longitudinal centre line of the pendulum arm falls within 1° of a vertical line at impact. The impactor shall be guided to exclude significant lateral, vertical or rotational movement at time-zero.

3.3.6. Allow a period of at least 30 minutes between successive tests on the same leg.

3.3.7. The data acquisition system, including transducers, shall conform to the specifications for CFC 600, as described in annex 8.

3.4. Performance specification

3.4.1. When the heel of each foot is impacted at 4,4 ± 0,2 m/s in accordance with paragraph 3.3., the maximum impactor acceleration shall be 340 ± 50 g.

Figure 1

Tibia impact test - test set-up specifications

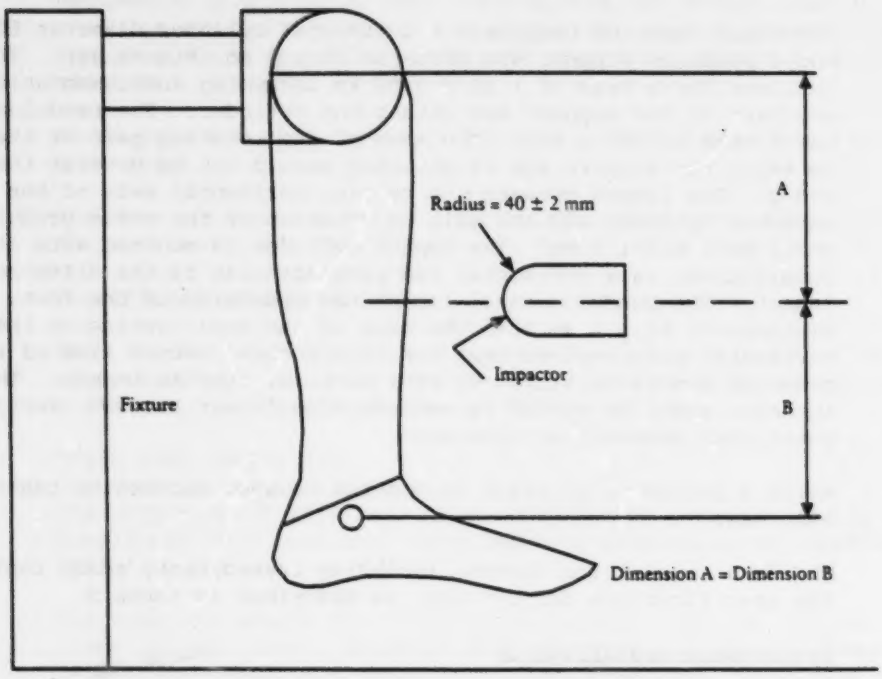


Figure 1a

Upper foot impact test - test set-up specifications

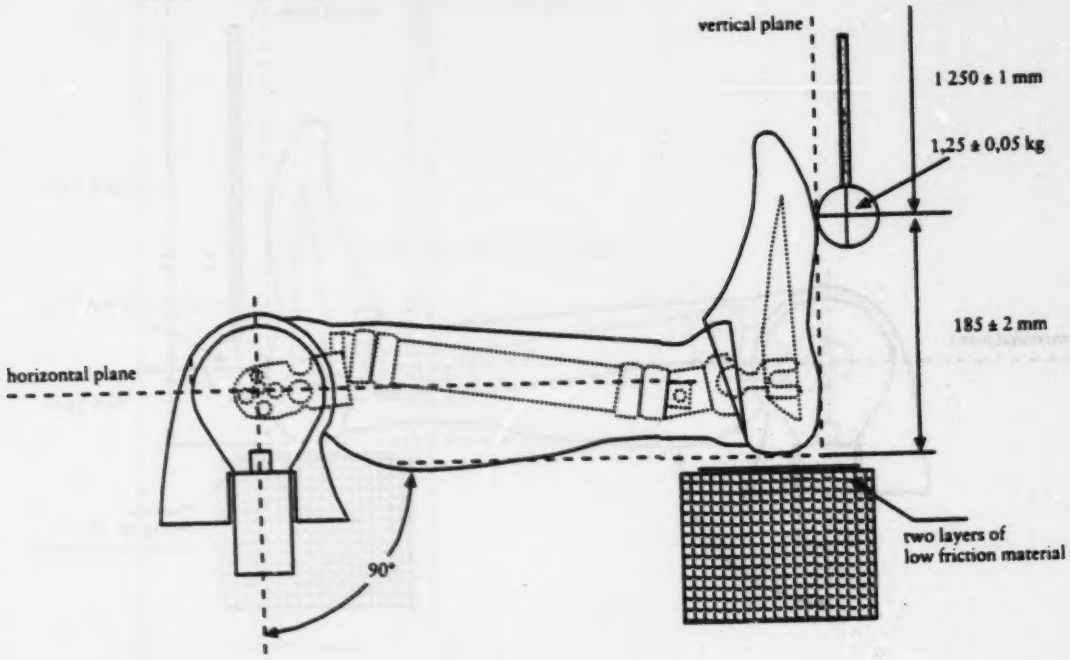


Figure 1b

Lower foot impact test - test set-up specifications

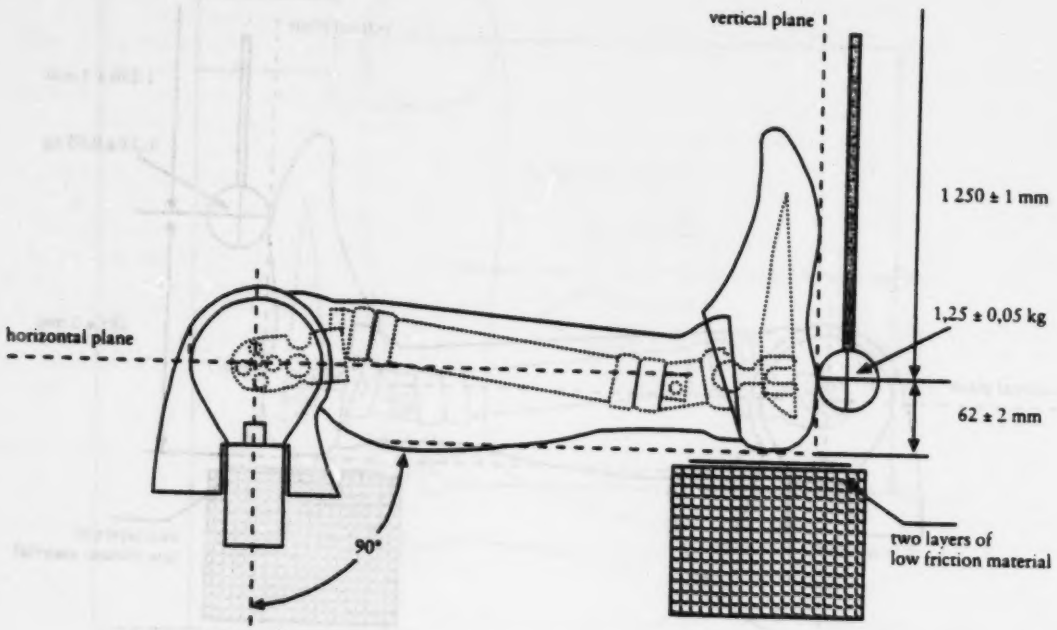


Figure 2

Upper foot impact test - test set-up specifications

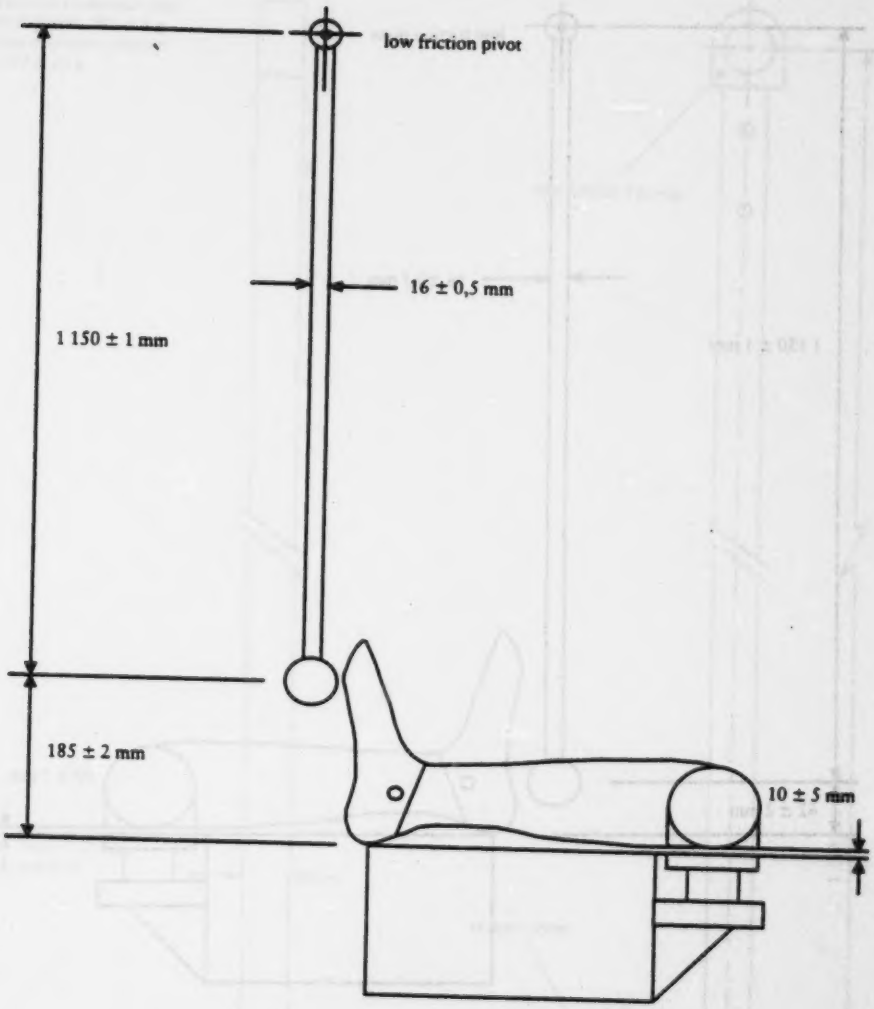


Figure 3

Lower foot impact test - test set-up specifications

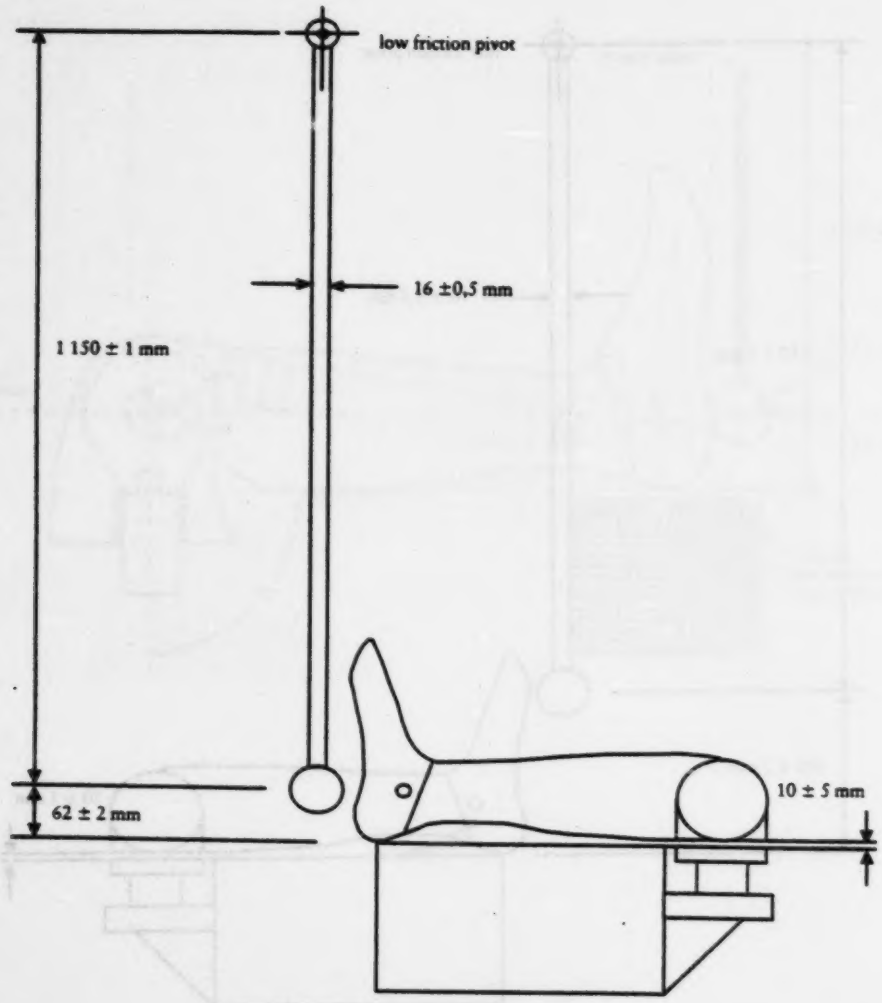
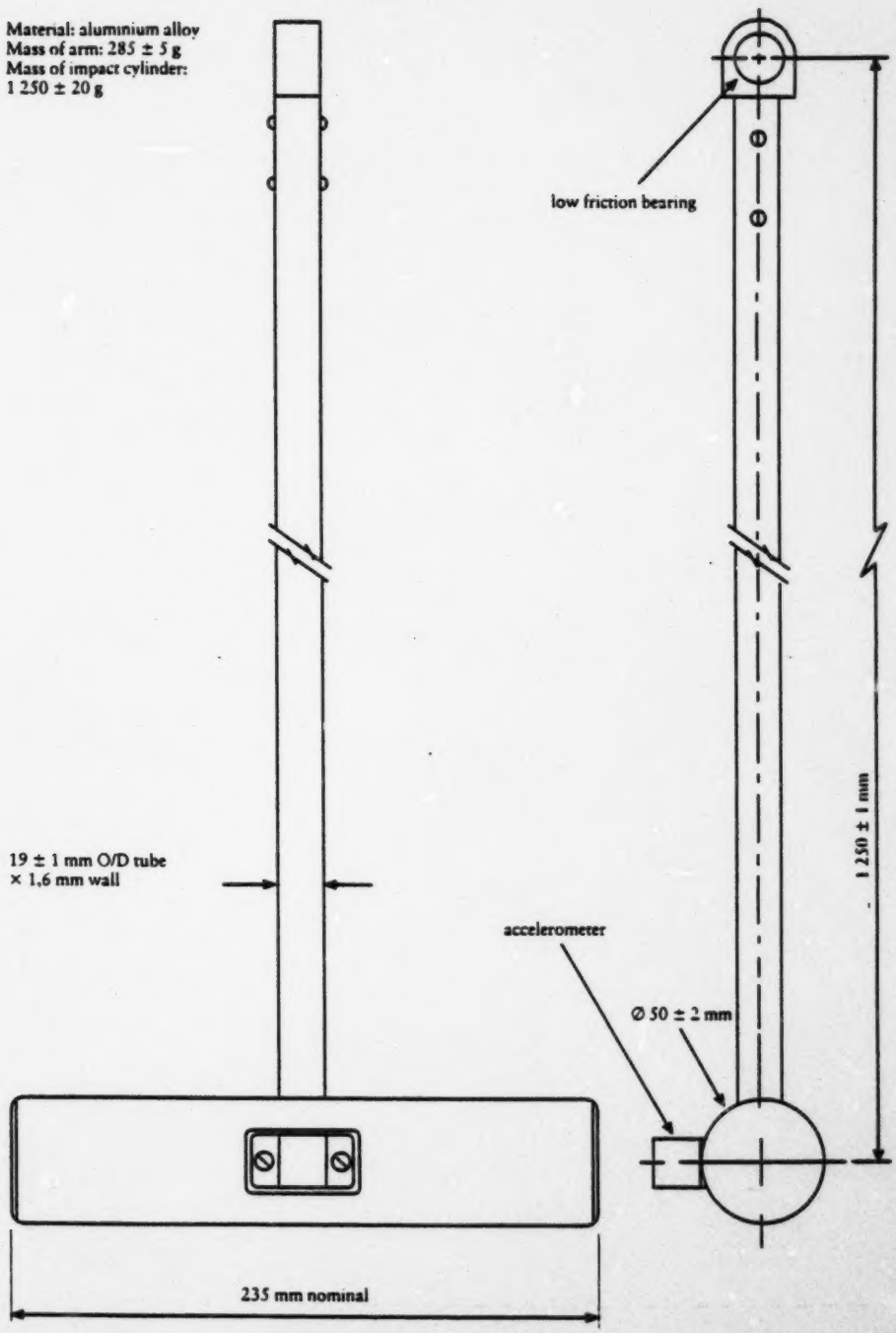


Figure 3a

Pendulum impactor


Material: aluminium alloy
Mass of arm: 285 ± 5 g
Mass of impact cylinder:
1 250 ± 20 g
low friction bearing
19 ± 1 mm O/D tube
× 1,6 mm wall
accelerometer
Ø 50 ± 2 mm
1 250 ± 1 mm
235 mm nominal